



UNIVERSITI PUTRA MALAYSIA

***CHARACTERIZATION OF DEFECTS IN UNIDIRECTIONAL KENAF FIBER-
REINFORCED POLYURETHANE COMPOSITES USING INFRARED
THERMOGRAPHY TECHNIQUE***

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THERMOGRAPHY TECHNIQUE**



By

ZAHRA DASHTIZADEH

**Thesis Submitted to the School of Graduate Studies, University Putra Malaysia, in
Fulfillment of the Requirement for the Degree of Master of Science**

May 2012

DEDICATION

This work is dedicated to:

My parents,

Your encouragement and comforting words is a tonic for my soul.

My husband,

Your dynamic and generous spirit continues to enrich my life.

My parents' in-laws,

Your supportive friendship and encouragement is the peace of my life.

My brothers,

Your friendship is a treasure beyond comparison.

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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Quality control is always an important issue in industrial production. According to economics, it is more convenient to check the structural integrity and the quality of a product before it gets damaged in site. Kenaf/Polyurethane (PU) composites have potential application as “insulators” in buildings since the current insulators, such as the asbestos are dangerous for human health and can cause lung cancer. The purpose of this study was to determine the capabilities of infrared thermography in detecting and characterizing the defects in kenaf/PU composites.

Kenaf/PU composites having three different weight contents (40/60, 50/50 and 60/40 Kenaf / PU weight %) were manufactured, then cut into three different thicknesses (9mm, 6mm and 4mm) to study the effect of thickness on the infrared images. Active thermography method was applied and the thermal images were captured for investigating the defects. The scanning electron microscopy (SEM) was used to provide a micrograph as an evidence for the thermography results.

The results show that the 6mm thickness in all cases has more defects in terms of area as compared to the 4mm and 9mm thickness. Moreover, the SEM micrographs have confirmed that the defective areas have defects such as voids, fiber pulled out, fiber break out that are the results of weak interfacial adhesion between kenaf and PU. In addition, the results also determine that voids and PU-rich zone are the defects that can be easily captured while the delamination and crack are the defects that are hard to be captured. Also, thermal images indicate that the amount of fiber plays an important role in the thermal images, since the thermal image of a 60% kenaf board is different from a thermal image of a 50% or 40% kenaf boards. Therefore, SEM morphology as evidence has proven that thermography is able to detect the surface and subsurface defects like voids and PU-rich zones.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENCIRIAN KECACATAN DALAM KOMPOSIT POLIURETENA DIPERKUAT
GENTIAN KENAF SATU ARAH MENGGUNAKAN TEKNIK TERMOGRAFI
INFRAMERAH**

Oleh

ZAHRA DASHTIZADEH

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Pengerusi : Profesor Aidy Ali, PhD

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Kawalan kualiti merupakan isu yang penting dalam industri pengeluaran dan menurut ekonomi, adalah lebih mudah untuk memeriksa integriti struktur dan kualiti sesuatu produk sebelum ia mengalami kerosakan di tapak. Komposit kenaf/poliuretana (PU) mempunyai potensi untuk diaplikasikan sebagai “penebat” dalam bangunan di mana penebat yang digunakan sekarang iaitu asbestos berbahaya kepada kesihatan manusia dan boleh menjadi penyebab kepada barah paru-paru. Tujuan kajian ini adalah untuk menentukan keupayaan termografi inframerah dalam mengesan dan mencirikan kecacatan pada komposit kenaf/PU.

Komposit kenaf/PU yang mempunyai tiga kandungan berat yang berbeza (40/60, 50/50 dan 60/40 Kenaf / PU berat%) telah dihasilkan dan kemudian dipotong kepada tiga ketebalan yang berbeza (9 mm, 6 mm dan 4 mm) untuk mencirikan kesan ketebalan dalam keputusan imej inframerah. Kaedah termografi aktif telah digunakan, kemudian imej terma ditangkap untuk mengkaji kecacatan, dan mikroskop pengimbas electron

(SEM) digunakan untuk menyediakan mikrograf sebagai bukti untuk keputusan termografi.

Keputusan menunjukkan pada ketebalan 6 mm untuk setiap kes mempunyai kecacatan yang lebih tinggi berbanding ketebalan 4 mm dan 9 mm. Tambahan pula, mikrograf SEM telah meluluskan bahawa kawasan cacat yang mempunyai kecacatan seperti lompong, penarikan keluar gentian dan pematahan gentian adalah keputusan daya rekatan antara muka yang lemah antara kenaf dan PU. Di samping itu, keputusan kajian ini juga menentukan bahawa lompong dan kawasan diperkaya PU adalah kecacatan yang boleh ditangkap dengan mudah manakala penyahikatan antara gentian dan matrik dan keretakan adalah kecacatan yang sukar untuk ditangkap. Imej terma juga menunjukkan bahawa jumlah serat memainkan peranan penting dalam imej terma, di mana imej terma untuk 60% papan kenaf adalah berbeza dengan imej terma untuk 50% atau 40% papan kenaf. Oleh itu, SEM telah membuktikan bahawa termografi dapat mengesan kecacatan permukaan dan subpermukaan seperti lompong dan kawasan yang diperkaya PU.

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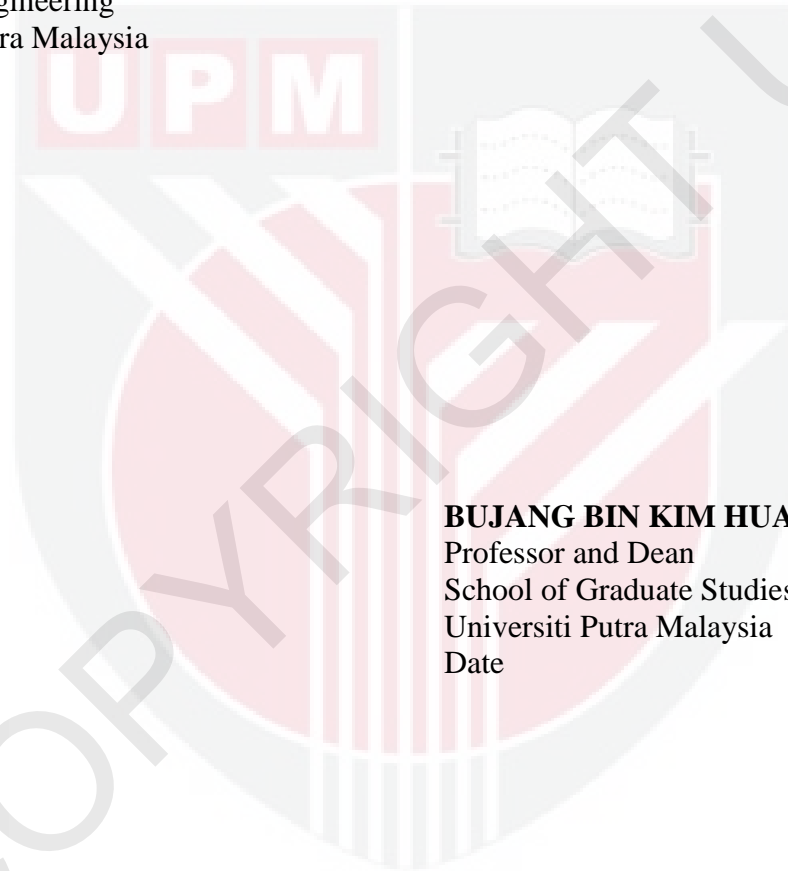
This thesis was submitted to the Senate of University Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at University Putra Malaysia or other institutions.



ZAHRA DASHTIZADEH

Date:

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